

Translation

PATENT COOPERATION TREATY

PCT

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PCT/EP2003/001577



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference<br>BO2/0051PC/crt  | <b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |   |
| International application No.<br>PCT/EP2003/001577   | International filing date (day/month/year)<br>17 February 2003 (17.02.2003)   | Priority date (day/month/year)<br>19 February 2002 (19.02.2002) |
| International Patent Classification (IPC) or national classification and IPC<br>C07C 2/52, 5/367 |   |   |
| Applicant<br>BASF AKTIENGESELLSCHAFT   |   |   |

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| 1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.  |
| 2. This REPORT consists of a total of <u>5</u> sheets, including this cover sheet.<br><br><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).<br><br>These annexes consist of a total of _____ sheets.  |
| 3. This report contains indications relating to the following items:<br><br>I <input checked="" type="checkbox"/> Basis of the report<br>II <input type="checkbox"/> Priority<br>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability<br>IV <input type="checkbox"/> Lack of unity of invention<br>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement<br>VI <input type="checkbox"/> Certain documents cited<br>VII <input type="checkbox"/> Certain defects in the international application<br>VIII <input type="checkbox"/> Certain observations on the international application |

|   |  |
|---|--|
| Date of submission of the demand<br>28 August 2003 (28.08.2003) | Date of completion of this report<br>12 July 2004 (12.07.2004) |
| Name and mailing address of the IPBA/EP<br><br>Facsimile No.    | Authorized officer<br><br>Telephone No.                        |

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/EP2003/001577

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

- ☒ the international application as originally filed
- ☒ the description:  
pages \_\_\_\_\_ 1-25 \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☒ the claims:  
pages \_\_\_\_\_ 1-9 \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, as amended (together with any statement under Article 19  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☒ the drawings:  
pages \_\_\_\_\_ 1-4 \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☐ the sequence listing part of the description:  
pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/fig \_\_\_\_\_

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

|                               |        |       |     |
|-------------------------------|--------|-------|-----|
| Novelty (N)                   | Claims | 1 - 9 | YES |
|                               | Claims |       | NO  |
| Inventive step (IS)           | Claims | 1 - 9 | YES |
|                               | Claims |       | NO  |
| Industrial applicability (IA) | Claims | 1 - 9 | YES |
|                               | Claims |       | NO  |

### 2. Citations and explanations

Reference is made to the following documents:

- D1: US-A-2 376 985 (VANDERVEER VOORHEES)  
29 May 1945 (1945-05-29)
- D2: US-A-2 438 041 (DUTCHER HARRIS A)  
16 March 1948 (1948-03-16)
- D3: US-A-5 196 621 (BURDETT KENNETH A ET AL)  
23 March 1993 (1993-03-23), cited in the application
- D4: US-A-4 029 715 (RIEVE ROBERT W ET AL)  
14 June 1977 (1977-06-14), cited in the application
- D5: WO 94 01385 A (DOW CHEMICAL CO)  
20 January 1994 (1994-01-20)
- D6: US-A-3 502 736 (SATO MIKIO ET AL)  
24 March 1970 (1970-03-24), cited in the application
- D7: US-A-5 321 180 (DAVIS CLARK S)  
14 June 1994 (1994-06-14)
- D8: CANADIAN CHEMICAL NEWS, 36(3), 1984, pp 19-24,  
"LPGs - putting a Canadian resource to new use", XP8027075.

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**Novelty (PCT Article 33(2))**

D1 discloses the production of 4-vinyl cyclohexane from butadiene but makes no reference to the dehydrogenation of n-butane to yield butadiene. The present application is therefore novel over D1.

**1. Inventive step (PCT Article 33(3))**

According to the application (see description, page 2, lines 15-19), the problem addressed by the invention is that of providing an improved method (fewer coupling products) for the production of 4-vinyl cyclohexane, ethyl benzene, and styrene.

D1 to D7 discloses different methods for the production of styrene and/or ethyl benzene from butadiene.

D1 discloses the dimerisation of butadiene, containing 4-vinyl cyclohexane. The 4-vinyl cyclohexane can also be separated and the by-product returned (page 1, column 2, lines 27-34). 4-vinyl cyclohexane is converted by catalytic dehydrogenation to styrene. The production of ethyl benzene is also mentioned in D1 (page 2, column 2, line 68 to page 3, column 1, line 12).

However, the problem of interest is solved by the method according to the invention, using butadiene which is obtained by dehydrogenating n-butane. The dehydrogenation of n-butane does not yield large quantities of acetylenically unsaturated

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hydrocarbons or allenes as by-products. When butadiene that has been obtained by cracking hydrocarbons is used, the butadiene dimerisation has to be preceded by a hydrogenation step.

The subject matter of claims 1-9 can therefore be considered inventive.